

# NOAA'S NATIONAL WEATHER SERVICE

## STRATEGIC PLAN

### 2011 – 2020

Draft for public comment

July 27, 2010

Provide your feedback at [www.weather.gov/com/stratplan](http://www.weather.gov/com/stratplan)

## Mission

Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy

## Vision

A safe, healthy, and productive society through trusted weather, water, and climate information

## Goals

- Improve weather decision services for events that threaten safety, health, the environment, economic productivity, or homeland security
- Deliver a broad suite of improved water services to support management of the Nation's water supply
- Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks
- Improve sector-relevant information in support of economic productivity
- Enable integrated environmental services supporting healthy communities and ecosystems
- Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission

## CONTENTS

LETTER FROM THE ASSISTANT ADMINISTRATOR .....	3
INTRODUCTION .....	4
THE PLAN .....	6
Goal 1: Improve weather decision services for events that threaten safety, health, the environment, economic productivity, or homeland security.....	9
Goal 2: Deliver a broad suite of improved water services to support management of Nation’s water supply.....	11
Goal 3: Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks.....	12
Goal 4: Improve sector-relevant information in support of economic productivity.....	14
Goal 5: Enable integrated environmental services supporting healthy communities and ecosystems	16
Goal 6: Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission .....	18
COLLABORATION AND PARTNERSHIP .....	19
IMPLEMENTATION.....	20

## LETTER FROM THE ASSISTANT ADMINISTRATOR

I am pleased to present the National Weather Service (NWS) Strategic Plan.

Weather, water and climate affect each of us everyday – whether it’s a tornado or flood that threatens life and property, a severe weather outbreak which disrupts air traffic, or just a minor inconvenience due to hot and humid weather. The National Weather Service has the responsibility to provide weather, water and climate information to protect life and property and enhance the economy. We have met this responsibility for many years and, I hope you would agree, we have done it well.

However, population growth, vulnerable infrastructure, and an increasingly interdependent economy are creating new challenges for the Nation – including increased vulnerabilities to weather and climate. At the same time, science and technology are rapidly advancing and providing potential solutions that will enable the National Weather Service to better meet our country’s needs. This strategic plan is our best effort to anticipate service needs in the 2020 time frame, project what science and technology will allow, and establish meaningful outcome-oriented goals and objectives for NWS 2020.

The plan also provides a strategic framework that will guide our organization and investment over the next ten years. We hope this strategy will prepare NWS to meet the challenges and opportunities of the future – continuing to deliver today’s mission and expanding to meet the growing needs of the country.

Our Strategic Plan is aligned with NOAA’s Next Generation Strategic Plan and is the result of a collaborative effort among our employees and the NWS Employees Organization (NWSEO), NOAA and NWS management, and our partners in the public, private and research sectors.

Our success in executing the plan will depend critically on teamwork – within NWS and NOAA and with our partners in the public, private and academic communities. We will continue to closely collaborate with our NOAA colleagues as we develop more detailed strategies and implementation plans. Our success depends on the capabilities of all of NOAA. Collectively, we must be creative and innovative in our thinking, willing to embrace change and committed to achieving success that will benefit all Americans – especially during challenging economic and budgetary times. Following this path will enable NWS to become more capable, better equipped and more agile in providing service to our country -- providing more timely, high-quality weather, water and climate information for decision makers at all levels and contributing to safer, healthier, and more productive communities, ecosystems and economies.

Dr. John “Jack” L. Hayes

NOAA Assistant Administrator for Weather Services  
and Director National Weather Service  
National Oceanic and Atmospheric Administration

## INTRODUCTION

The National Weather Service (NWS) has played a key role in protecting American lives and properties for over a century. The timely provision of reliable weather, water, climate, and environmental information has supported the Nation's social and economic development. NWS offices in communities across the United States and its territories, supported by regional and national centers, provide the authoritative information needed by Americans, including national, regional, state, tribal, and local authorities, to plan, prepare, mitigate, and respond to natural and human-caused events.

The NWS is part of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), an agency with a diverse mission to understand and communicate changing conditions in the weather, climate, oceans, and coasts and use that understanding to manage natural resources, including managing the Nation's fisheries and supporting healthy coastal habitats and species. NWS expertise in weather, water, and climate prediction, contributes to NOAA-wide initiatives such as air and water quality forecasts and ecological prediction and monitoring. NOAA's commitment to science, service, and stewardship informs society to respond and adapt to environmental conditions within a changing and uncertain world.

As the world has changed, so too has the NWS, advancing our scientific and technical capabilities to better meet the needs of Americans. During the 1980s and 1990s, NWS deployed state-of-the-art observing and computing systems, improved modeling capabilities, re-aligned the organization to better deliver services, and made substantial investments in training and recruitment. The result was an organization with a greater capacity to provide timely information to save lives and avert disaster.

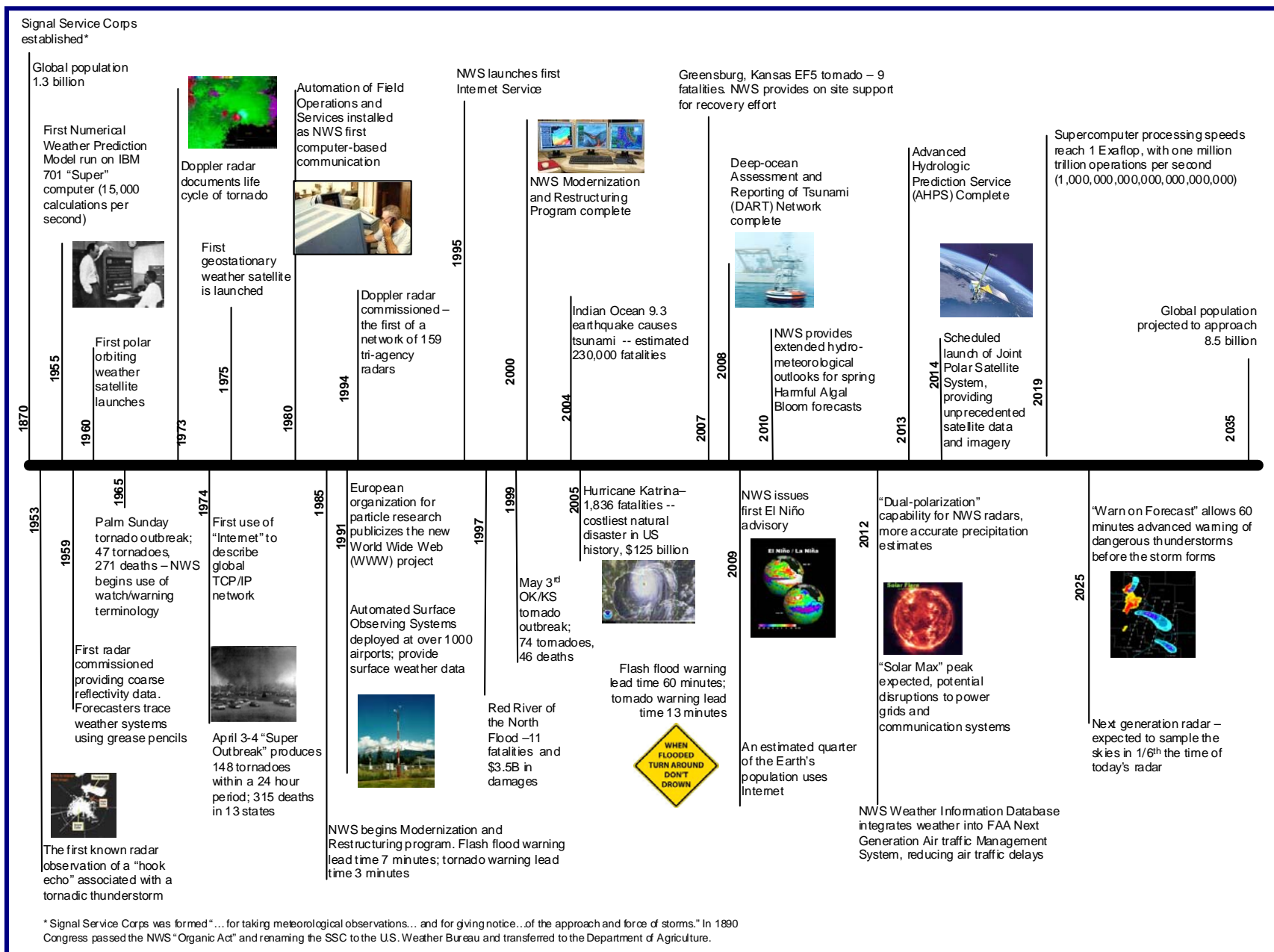
Today our science and services continue to evolve and improve to meet emerging needs. For example, NWS forecasters are working closer than ever with emergency responders to prepare for and avoid the impacts of natural and human-caused events. Space weather prediction and warnings are helping protect our Nation's infrastructure, and climate outlooks are contributing to the management of the Nation's water resources, energy supply and food security. We are also responding to the changing ways people communicate, network, and share information, and we are using new technologies to make information more accessible and interoperable.

Over the next ten years, weather, water, climate, and environmental information will play a greater role in the significant decisions we make as individuals and as a society – from the quantity and quality of water we need and the quality of the air we breathe, to the generation and distribution of renewable energy, the safe passage of our country's highways, railways, seas, and airways – making everyday life safer, healthier, and more productive.

The timeline below encapsulates the evolution of NWS from its inception to the future, including the significant events and advancements that have shaped or will influence our services to the country.

In 1950, an F5 tornado devastated the town of Udall, Kansas, killing 68 percent of the town's residents. In 2007 an F5 tornado similar in makeup to the Udall tornado ripped through Greensburg, Kansas destroying the town. Emergency managers on the scene expected a death toll in the hundreds. Unlike Udall, Greensburg residents were prepared as a result of advances in the NWS warning system, radar improvements, and a strong partnership among NWS, emergency responders, media, and private sector. The number of fatalities in Greensburg was 9 - a casualty rate less than 7 percent of that in Udall 57 years earlier.

## NWS EVOLUTION AND INNOVATION: PAST TO FUTURE



## THE PLAN

***NWS Vision:** A safe, healthy, and productive society through trusted weather, water, and climate information*

**New and evolving needs from society call for a shift in the way we forecast and warn to provide impact-based decision support services.** This means we must place an increasing emphasis on weather-related events which significantly affect people, their livelihoods and the economy. We must go beyond producing accurate forecasts and timely warnings to better understanding and anticipating the likely human and economic impacts of such events. We must enable our users to better exploit NWS information to plan and take preventive actions so people remain safe, less damage is done to communities, businesses, and the environment, and economic productivity is maximized. Specifically, impact-based decision support services will require us to:

- Produce highly accurate and specific forecasts that integrate human, economic, cultural, risk and uncertainty criteria for weather-related events that impact safety, health, the economy, environment, or homeland security
- Understand socioeconomic impacts of how and what we forecast and warn to target those at risk and communicate information in ways so people fully understand and respond
- Engage with sectors whose safety, health, productivity, or security is at-risk: transportation and public health officials, water resource managers, natural resource managers and others

Operationally impact-based decision support means our forecasters will require an expanded understanding of the weather-related decisions users must make. Forecasters will focus less on improving increasingly accurate model output and more on maintaining continuous situational awareness, interpreting information and providing decision support for high-impact events. We envision our offices as decision support hubs, collaborating with public and private partners, to deliver integrated environmental information for NOAA and other agencies. We envision our national prediction centers continuing to collaborate with local and regional offices to provide weather, water, climate, and other environmental predictions within an Earth system framework. We intend to continue working closely with our public and private sector partners and users, empowering them to gain full value from our information.

**Scientific and technical advancements are essential enablers for providing impact-based decision support.** Most notably, the planned four-dimensional environmental database, or 4D Cube, and associated forecaster tools will transform operations by integrating weather, water, climate, and environmental observations, forecasts, and decision-making into a network-enabled, continuously updated “virtual” repository. The result will be a common, nationally-consistent, real-time weather

### Impact-Based Decision Support – What Is It?

Information and Expertise  
Plus  
Social and Economic Risks and Impacts

Targets the individuals and economic  
sectors at-risk

Requires knowledge and understanding  
of user needs

**Why?** Minimize the Human and  
Economic Impacts

picture, allowing forecasters to easily analyze forecast challenges, monitor uncertainty, and make prognoses. The forecast team will be at the center of the information system producing and delivering information to enable human decisions that affect outcomes. Linking social and physical sciences to produce and communicate information will be critical to our success. Next-generation observations, Earth system models at all possible spatial and temporal scales, and advanced technologies will be enablers, expanding capabilities to warn-on-forecast and to quantify forecast uncertainty. These measures will extend the window America has to prepare for weather-related events that impact society.

**Our workforce and partnerships are vital to the success of impact-based decision support.** NWS will develop strategies and commit resources to train our workforce beyond weather, water, and climate sciences. Forecasters will be better communicators and interpreters of NWS information, and understand the risks and impacts implied by our forecasts. We want to recruit world-class scientists, meteorologists and hydrologists who have communication, social science, and information technology skills. We want to recruit and partner with people from other disciplines: economists, behavioral scientists, ecologists, oceanographers, engineers, health experts, and the like. We want to better leverage the expertise and resources of our partners in the public and private sectors.

The next section, “Achieving Our Vision,” outlines the details of our strategic plan. It describes the long-term, mutually supportive goals which contribute to outcomes for society. These are outcomes we cannot control alone but ones where our capabilities can have a positive impact on global decisions and the many challenges we face as a Nation. Examples of such outcomes are defined as measures of success for each goal. Below each goal, objectives and high-level strategies focus on service delivery and science and technology. Many of the strategies support the achievement of multiple goals.

#### **What is a High-Impact Event?**

No standard, nationwide criteria define a high-impact event. It could last minutes or months. It may impact millions of people or one sector, and it may vary in timing or location.

It is any weather-related event that significantly impacts safety, health, the environment, economic productivity, or homeland security, such as:

- Persistent drought
- Convection in a congested air space
- Rains that trigger flooding and cause agricultural run-off, leading to harmful algal blooms and dead zones
- Geomagnetic storms that disrupt energy distribution and communication systems
- Snow squalls at rush hour
- An above-average hot day

## WHAT IS THE 4D CUBE?

The four-dimensional environmental database, or 4D Cube, is a continuously-updated “virtual” repository containing observations, analysis and forecast information. It is the technological foundation for transforming all NWS services. It is also the NWS component of the Next Generation Air Transportation System, known as NextGen.

The 4D Cube will enhance decision support systems, offering consistent information at high temporal resolutions. Information will be available and useable in real-time, enabling push/pull data capabilities and two-way information sharing. Information will be rapidly updated, disseminated in seconds, and available in flexible formats.

The 4D cube will transform how the public and decision makers access information. It will also transform NWS operations. NWS forecasters will be at the center of the information hub, using tools and decision support applications to interact with the 4D Cube. It will enable forecasters to better maintain situational awareness, focus on scientific interpretation, and monitor forecast challenges with the goal of providing impact-based decision support.

NWS will establish a basic version of the aviation component of the 4D Cube for use in the NextGen architecture in 2013. Users will include members of the Air Transportation System, such as Department of Transportation, FAA, Department of Defense, airlines, and broader weather industry. The role of NWS will be to serve as the expert on the science and contents of the 4D Cube.

As information providers other than NWS adopt data management and data discovery methods based on the 4D Cube, users will be able to discover and use not just NWS information, but also information provided by other government agencies, researchers, and private companies. By 2020, the 4D Cube will become an integrated access point for all of the Nation’s environmental information.



## ACHIEVING OUR VISION

### NWS GOALS

- GOAL 1: Improve weather decision services for events that threaten safety, health, the environment, economic productivity, or homeland security
- GOAL 2: Deliver a broad suite of improved water services to support management of the Nation's water supply
- GOAL 3: Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks
- GOAL 4: Improve sector-relevant information in support of economic productivity
- GOAL 5: Enable integrated environmental services supporting healthy communities and ecosystems
- GOAL 6: Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission

### GOAL 1: IMPROVE WEATHER DECISION SERVICES FOR EVENTS THAT THREATEN SAFETY, HEALTH, THE ENVIRONMENT, ECONOMIC PRODUCTIVITY, OR HOMELAND SECURITY

Urbanization and a growing population are increasingly putting society in harm's way of weather, water and climate events. For a growing number of people living in coastal communities, hurricanes, typhoons, and tsunamis threaten livelihoods and cause major damage to property and infrastructure. People who live along rivers and other inland waterways face increasing disruption because of more frequent and devastating flooding. Winter storms paralyze cities and regions for days and cost billions in cleanup and lost productivity. Tornadoes can take lives and destroy entire communities within a matter of seconds, while wildfires can burn for weeks threatening homes and natural habitats. Indirect impacts of these events, such as infrastructure failures, illness, and emotional trauma, can be just as significant. This goal seeks to minimize or even prevent such human and economic impacts.

**Measures of Success:** Improved community emergency preparedness leading to fewer fatalities from weather-related events; less economic losses from unnecessary evacuations and property damage

**Objective:** Provide demand-driven, impact-based weather services

#### Strategies for Achieving

- *Impact-Focused Services:*
  - Provide impact-based forecasts by tailoring forecasts to user-defined thresholds with objective uncertainty to communicate human, economic, and environmental impacts and risks
  - Redefine warnings to focus on a broad range of high impact events targeting those at-risk
  - Develop methods, working with partners, to evaluate the economic and societal impact and relevance of NWS information. Apply results to improve services.

- *Decision Support:*
  - Increase direct, interpretive support to public sector officials and emergency responders for incidents of national, regional, or local significance
  - Improve and expand use of new technologies to communicate with partners, users and employees across NOAA. Examples of such technologies include advanced visualization tools, collaboration, mobile, video, and voice
- *Dissemination:* Leverage, in collaboration with partners, emerging dissemination methods to warn those specifically impacted by weather-related events
- *Outreach & Education:* Improve the preparedness and resiliency of those at-risk to the impacts of weather-related events through impact-based outreach and education. Continue to promote community preparedness programs, such as TsunamiReady™ and StormReady®
- *Partnerships:* Continue to engage and collaborate on global, national, and regional issues; and strengthen and broaden effective partnerships with other agencies, public and private sector partners, including America's weather and climate industry

**Objective: Utilize emerging science and technology to improve weather prediction**

**Strategies for Achieving**

- *Observations:* Advance and deploy next generation integrated observing systems to address the Nation's need for real-time weather and climate data, in partnership with NOAA, other agencies, and private sector
- *Earth System Modeling:* Develop and implement, with research community and other partners, high-resolution Earth system models, including land, atmosphere, ocean, and cryosphere components for multiple time and space scales
- *Forecast Uncertainty:* Develop and implement steps toward quantifying and communicating forecast uncertainty achieved through physical and social science research, ensemble model and forecast system improvements, and tools that assist users in applying forecast uncertainty in their decision making
- *Forecaster Tools:* Develop and implement, with research community and other partners, forecaster tools that support data mining, enhanced visualization, smart decision assistance, and forecaster coordination and collaboration.
- *Data Access & Interoperability:* Extend access to weather, water, climate, and environmental data using national and international systems and standards, such as Global Earth Observation System of Systems (GEOSS), WMO Information System (WIS), internet and other technologies
- *Social Science:* Integrate social science research, methods, and capabilities into science service areas, forecaster tools, and decision support systems
- *Partnerships:* Build and strengthen partnerships to find and influence emerging technologies and define requirements to accelerate transition of research into operations

- *Transition of Research:* Develop, in partnership with the research community, common modeling and operating infrastructures as well as testbeds to facilitate scientific and technological development and to accelerate the transition of research into operations

*Advance science and technology in key areas where weather, water and climate impact society:*

- *Severe Weather:* Develop neighborhood-scale forecasts and warnings achieved by advancing warn-on-forecast for convective weather, improving quantitative precipitation forecasts, and improving tornado forecast skill
- *Hurricanes and Cyclones:* Develop finer-scale and more accurate track, intensity and inundation forecasts by advancing observations and high resolution modeling for multiple scales
- *Winter Weather:* Deliver storm-based winter weather watches, warnings, and advisories by increasing skill and precision for all winter weather variables
- *Fire Weather:* Advance and deploy better observing systems, fire-scale models, forecaster and decision support tools
- *Tsunami:* Improve tsunami detection, forecasting, and information based on better understanding of tsunamis, upgraded observations, higher resolution models, and improved data assimilation

## **GOAL 2: DELIVER A BROAD SUITE OF IMPROVED WATER SERVICES TO SUPPORT MANAGEMENT OF THE NATION'S WATER SUPPLY**

Whether too much, not enough, or of poor quality water is a major national challenge. Water for homes, agriculture, energy, and industry is already in short supply. In 2007 Atlanta, Georgia, came within three months of running out of water. Lake Superior, the Earth's largest freshwater body by surface area, was too shallow to float fully-loaded cargo ships, and a lack of water led regulators in Idaho, Arizona, and Montana to deny permits for new coal-fired power plants. A growing population and more frequent, persistent drought and flooding will only make the Nation's water management all the more challenging. Clean, safe water is also a growing challenge for communities and ecosystems. Water quality is being affected by changing water temperatures and an increase in salinity, nutrients, and other pollutants. This goal seeks to integrate and extend NWS water prediction capabilities to provide information and forecasts for a full suite of water services to better enable water resource managers to make preventative, proactive decisions in a changing and uncertain environment.

**Measures of Success:** Less economic loss and property damage from flooding as a result of impact-based decision support; more efficient management of municipal water supplies using integrated water forecasts and information; positive economic, ecological, agricultural impacts realized from forecasting water temperature, soil moisture and other parameters

**Objective: Develop cross-government, integrated water resource services**

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Decision Support:* Develop and deliver, with partners, decision support tools for water resource managers, focusing on climate-related impacts for arid and coastal watersheds, based on interoperable high resolution summit-to-sea water resources data

and information from multiple government partners, including U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE)

- *Water Resource Services:* Expand services to provide forecasts for such parameters as water flow, temperature, quality, dissolved oxygen content, and soil moisture conditions for inland and coastal watersheds

**Objective: Advance science and technology to improve and expand water forecasting**

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Research & Development:* Advance understanding of precipitation, temperature, evaporation and other hydrologic processes in an Earth system framework; integrate into models
- *Observations:* Leverage our partners' observations and expand our own river, surface, and remote observations
- *Modeling & Prediction:*
  - Improve quantification of hydrologic forecast uncertainty and apply social science techniques to improve the communication of uncertainty
  - Reduce hydrologic forecast uncertainty through cost-effective assimilation of all available informative data sources.
  - Integrate long-range weather forecasting into hydrologic modeling
  - Advance hydrologic and hydraulic modeling capabilities, including high and low flow, storm surge, and inundation mapping
  - Implement higher resolution, coupled models for rivers, lakes, and estuaries
- *Partnerships:* Advance hydrologic services by leveraging the science and technology of partners within NOAA, other agencies including the USGS and the USACE, the private sector, and academia

**GOAL 3: ENHANCE CLIMATE SERVICES TO HELP COMMUNITIES, BUSINESSES, AND GOVERNMENTS UNDERSTAND AND ADAPT TO CLIMATE-RELATED RISKS**

In the recent past, changes in climate can be seen in an increased average global temperature, melting of sea ice, rising sea levels, and increasing ocean acidification. Seasonal precipitation patterns have changed and weather-related events have increased in intensity and even frequency. Whether these changes are part of a natural cycle of climate variability or indicative of permanent change is still a matter of scientific debate; however, the impacts are vast, affecting all aspects of our ecosystems, society, and economy. Along our coastlines, changes in sea level rise could have an impact on housing and development, transportation, commerce, and the economy. In the Arctic, melting sea ice is already impacting natural habitats while providing opportunities for opening new sea routes for commerce and tourism. In many regions of the country, climate is impacting our water resources, including municipal water supplies and ecosystems. This goal supports the efforts of NOAA to deepen scientific

understanding of climate, deliver climate services from global to local scales, and improve public knowledge of the impacts of a changing climate.

**Measures of Success:** Reduced economic losses in areas such as agriculture, water, and energy as a result of impact-based climate services; improved preparation and response to weather-related events based on climate forecasts; better management of environmental resources based on climate forecasts

**Objective: Enhance NWS services to support development and delivery of NOAA climate services**

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Impact Forecasts:* Create a seamless suite of forecasts to address regional-to-local needs and issues across multiple time and space scales working with NOAA and other partners
- *Decision Support:*
  - Engage local and regional users to better understand climate issues; respond by delivering expanded climate service portfolio with NOAA and public and private sector partners
  - Enhance decision support through integration of social and economic factors, better communication of risk and uncertainty, and by using visualization, web, and other technologies
- *Partnerships:* Strengthen local, state, and regional partnerships across various sectors; foster growth of an emerging climate service industry to serve diverse needs of America's economy

**Objective: Improve and expand climate modeling for time scales from weeks and seasons to years**

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Research & Development:*
  - Improve understanding of the linkages between weather and climate and enhance modeling and analysis capabilities to provide more reliable predictions of climate and extreme events on scales from weeks to seasons and years
  - Support a NOAA-wide research effort on the potential for routine decadal prediction
- *Observations:* Leverage NWS observing systems to contribute to a strong scientific foundation for adaptation and mitigation strategies and minimize gaps in our understanding of climate variability and change
- *Modeling & Prediction:*
  - Improve the capability, with NOAA and partners, to simulate and predict climate on multiple time scales within an Earth system framework
  - Develop, with NOAA and partners, forecast-downscaling techniques that add value to climate forecasts at regional and local scales

- Improve forecast skill for weeks 2-4, in collaboration with the external research community, including generation of related data sets, multi-model ensemble prediction system, improved data assimilation, test beds, and model test facility
- Incorporate the effects of climate change in our Nation's precipitation frequency estimates. Develop and implement techniques to update maximum precipitation estimates
- *Transition of Research:* Develop, in partnership with research community, common modeling and operating infrastructures and testbeds to facilitate scientific and technological development and to accelerate the transition of research into operations

#### **GOAL 4: IMPROVE SECTOR-RELEVANT INFORMATION IN SUPPORT OF ECONOMIC PRODUCTIVITY**

Minimizing economic loss while maximizing economic gain from routine and high-impact weather-related events are critical to maintaining global competitiveness and securing national infrastructure. Today transportation is disrupted by storms, hurricanes, and flooding causing delays, loss of lives and cargo. Weather accounts for 70 percent of all air traffic delays, costing billions of dollars to the economy. Many forms of renewable and alternative energy are weather and water-driven, requiring accurate, reliable forecasts to make critical production and management decisions. Extreme weather, like hurricanes, can disrupt oil and gas production, while the transmission of energy is vulnerable to extreme temperatures and geomagnetic storms. Space weather activity can also interfere with communications and transportation systems causing disruption and major economic loss. In the agriculture sector, global food supplies are highly sensitive to weather, water, and climate, impacting everything from crop yields to the health of livestock. While developing and honoring appropriate boundaries between NWS services and those provided by America's weather and climate industry, this goal seeks to provide environmental information to help America's industry better anticipate, plan, and make key decisions to increase economic productivity and protect lives and livelihoods.

**Measures of Success:** Gains in efficient renewable energy production; fewer weather-related aviation delays; mitigated economic loss in the agriculture sector; greater reliability in navigation services due to space weather forecasts and warnings; increased preparedness and response to maritime emergencies; increased value of the services provided by America's weather and climate industry

**Objective: Strengthen use of weather-related information for informed decision-making and risk management**

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Partnerships:* Proactively work with America's weather and climate industry to develop and implement complementary information services and decision tools to meet sector needs
- *Sector-relevant Data:* Make accessible data and information based on sector-relevant thresholds, impacts, and parameters using tools such as the 4D Cube

- *Sector Knowledge & User Needs:* Expand knowledge of sectors needs through collaboration with the private sector and other agencies
- *Decision Support:* Explore opportunities to increase weather, water, climate, and space weather interpretive support to other government agencies supporting energy, agriculture, transportation, emergency management, or homeland security

*Targeted areas for improvement include:*

- *Renewable Energy:* Engage the renewable energy sector and other agencies to expand observations, improve short-range to seasonal forecasts, and promote technical exchange and research, benefitting renewable energy production and transmission
- *Aviation:* Be FAA's lead federal partner, working nationally and internationally with public and private sector partners to achieve space weather needs and support a weather-safe national airspace
- *Surface Transportation:* Improve impact of road-weather forecasts on safety and road accessibility by increasing understanding of user needs, increasing decision assistance, and by strengthening partnerships with state and federal transportation agencies and private sector
- *Marine Weather & Transportation:* Increase engagement and collaboration with NOAA and marine transportation community to better understand user needs and improve the relevancy of marine weather and oceanographic data and information
- *Agriculture:* Participate in national and international efforts to tackle global food supply and water resource challenges by contributing modeling and prediction capabilities

**Objective: Improve forecast skill to accuracy and confidence levels required for decision-making and risk management**

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Observations:* Expand observations for roadways, marine, and aircraft; polar, planetary boundary layer, and space
- *Modeling & Prediction:* Extend temporal scales of weather prediction, from hours to weeks, with improved accuracy and confidence to support decision-making and mitigate economic loss

*Targeted areas for improvement include:*

- *Space Weather:* Improve forecasting at global and regional scales for geomagnetic storms, solar flares, and other particles by expanding observations; developing Earth system models coupling atmosphere, ionosphere, and magnetosphere; and improving data assimilation for application in energy, transportation, telecommunications, and other industries
- *Energy:* Provide weather, water, ocean, and climate information to meet energy sector needs by expanding observations in the planetary boundary layer,

improving models at needed temporal and spatial scales, and quantifying forecast uncertainty

- *Aviation:* Improve modeling and predictions for aviation parameters; develop tools for new forecasters; and integrate the 4D Cube to support a weather-safe national airspace
- *Marine Weather & Transportation:* Provide accurate, timely coastal and ocean data, forecasts, and warnings, based on coastal wave modeling research; new and integrated observations; global and regional coupled modeling

## **GOAL 5: ENABLE INTEGRATED ENVIRONMENTAL SERVICES SUPPORTING HEALTHY COMMUNITIES AND ECOSYSTEMS**

High-impact, weather-related events, such as extreme temperatures, poor air quality, and the transmission of air and water-borne diseases, pose significant risks to the health of individuals and communities. As of 2008, approximately 127 million U.S. residents live in counties where air pollution exceeds national standards, causing decreases in lung function, more frequent asthma-related hospital visits and even premature death. Even daily management of chronic illnesses, such as diabetes and cardiovascular diseases, are affected by temperature, precipitation, and humidity. These elements also affect the timing and intensity of infectious disease outbreaks, and changes in climate may alter their geographic range and evolution. More frequent heavy rains and flooding can trigger sewage overflows, spilling raw sewage into drinking water supplies, lakes and waterways, and beaches. Other pollutants in our inland and coastal waterways cause harmful algal blooms, dead zones, human illnesses, and concerns about the safety of seafood harvests. This goal seeks to support NOAA and other partners by linking weather, water, and climate with biological, chemical, ecological, and other processes to reduce the impact of health and environmental hazards on our communities and ecosystems.

**Measures of Success:** Health care providers are prepared for patients with weather and climate-sensitive illnesses, including air pollution and extreme temperatures, due to health-based forecasts; decreased occurrence of water-borne illnesses due to improved water and beach quality forecasts

**Objective:** Extend weather, water, and climate services to provide ecological and health-based forecasts and services

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Decision Support:* Expand outreach and decision support services in collaboration with our partners for persistent events, such as extreme heat or cold; seasonal flooding; drought
- *Partnerships:* Expand and build partnerships with local, regional, and national health, water and environmental managers to better understand and meet weather, water, and climate needs and explore new opportunities for collaboration

*Targeted areas for improvement include:*



- *Health-Based Forecasts:* Deliver, with NOAA and partners, information integrated to meet regional forecast needs, including: high resolution ozone, smoke, dust, and particulate matter forecasts; extreme temperatures; and the progression of insect and water-borne diseases
- *Ecological Forecasts:* Contribute, with NOAA and partners, the operational backbone for a defined suite of integrated ocean and coastal ecological forecasts and services, based on NOAA priority forecast areas of beach quality, species progression, dead zones, harmful algal blooms, and disease pathogen progression

**Objective: Harness evolving capabilities to enable ecological prediction**

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Research & Development:*
  - Research and develop, with NOAA and partners, ecological predictions, what-if scenarios, and projections
  - Improve climate, water, and weather forecasts for multiple time and space scales relevant to health risks and disease control impacting communities and ecosystems
- *Observations:* Expand weather, climate, and air quality observations to support environmental surveillance relevant to, and in partnership with, public health agencies
- *Modeling:*
  - Integrate long-range weather into ecological modeling within an Earth system framework
  - Contribute to improving regional ocean, estuary, and coastal circulation models, including biogeochemistry and ecosystem processes
- *Research to Operations:* Implement testbed framework to accelerate transition of ecosystem and health prototypes into operations and services

*Targeted areas for improvement include:*

- *Air Quality:* Expand air quality predictions for ozone, smoke, dust, and particulate matter, including research and development of airborne particulate matter, chemical data assimilation, and coupled meteorological and air quality predictions
- *Ecological Forecasting:* Initiate development of an ecological forecasting system, coupling air, land and water with biological, geological, chemical, and ecosystem processes

## **GOAL 6: SUSTAIN A HIGHLY-SKILLED, PROFESSIONAL WORKFORCE EQUIPPED WITH THE TRAINING, TOOLS, AND INFRASTRUCTURE TO MEET OUR MISSION**

**Measures of Success:** Increased knowledge of user needs; increased mix of interdisciplinary skills across workforce; improved employee satisfaction; operational collaboration and knowledge-sharing tools for NWS workforce; increased high performance computing capacity; expanded and sustained facilities and infrastructure; expanded availability and interoperability of environmental data

**Objective: Enhance knowledge and skills of our dedicated workforce**

### **Strategies for Achieving**

- *Training:*
  - Train workforce in climate science to make NWS a strong partner in the delivery of NOAA climate services
  - Increase and apply knowledge – through partnering, collaboration, and learning opportunities – of the missions and needs of NWS users across multiple sectors
  - Enhance development and training programs to improve and expand core competencies of all NWS employees, including more interdisciplinary areas such as, ecology and health, social sciences and economics, communication, information technology, leadership, and management
  - Implement new and enhanced methods and technologies for training delivery, such as simulations and on-demand training integrated into forecaster applications and other systems
- *Diversity:* Continue to promote and expand policies, programs, and practices that lead to a diverse workforce at all levels of the organization
- *Recruiting:* Improve recruitment strategies to ensure future workforce skills align with NWS vision, including hiring university-trained hydrologists, space weather forecasters, forecasters with training in social sciences and economics or other multidisciplinary skills
- *Succession Planning:* Partner with universities and professional societies on adapting curricula to emerging national and NWS needs
- *Regional Collaboration:* Continue to take a lead role in building and sustaining regional partnerships to better serve and adapt to changing needs
- *International Collaboration:* Continue to provide global leadership to advance NWS mission and vision by working with other countries and international organizations

**Objective: Provide state-of-the-art, reliable, secure, and extensible infrastructure**

### **Strategies for Achieving**

- *Information Technology & Communications:* Transform information technology and communication infrastructure to accommodate increasing data

- *Internal Communication & Collaboration:* Use emerging technologies and other tools to improve internal communication, collaboration, and knowledge sharing across NWS and NOAA
- *Computing:* Expand and sustain state-of-the-art computing architectures and high-performance computing to achieve modeling and prediction improvements
- *Observing Systems:* Seek new approaches and opportunities to ensure the integration and sustainment of NWS operational observing and dissemination systems
- *Facilities:*
  - Expand opportunities to co-locate NWS facilities with key partners, as well as sustaining existing facilities through “green” improvements
  - Ensure NWS facilities portfolio is appropriately aligned to support a reliable and secure work and living environment
- *Equipment:* Develop the next generation forecast and decision support system, to include data mining tools, advanced visualization, and interoperability with partner systems

## COLLABORATION AND PARTNERSHIP

The NWS recognizes the critical importance of collaboration and partnership with all NOAA offices and numerous public, private, and academic partners to achieve our vision for 2020. The dissemination, communication, and validation of NWS forecasts and warnings to the public are dependent on the media, emergency management community, and America’s weather and climate industry. NWS views this diverse and growing industry – the companies, media outlets, and others that create weather programming, provide consulting services, and deliver information to American society – as a key strategic partner that provides valuable services to many businesses while also being an important economic sector in its own right. With this plan the NWS hopes to contribute to the growth of this sector as well as benefit from new alliances and strengthened relationships.

NWS will work closely with local, state, and national emergency managers to better understand the information they need to assess risk and make decisions. NWS envisions interoperable technologies that will make collaboration with emergency managers easier and more seamless than today. Achieving our science and technology objectives will not be possible without the close collaboration and contributions of NOAA’s Office of Oceanic and Atmospheric Research (NOAA Research), along with numerous other academic and research institutions that provide a greater understanding of the Earth’s complex systems and help solve research challenges in the physical and social sciences. In addition to NOAA Research, the other mission offices that comprise NOAA will continue to play a vital role in our day-to-day operations and the success of our future. These offices are<sup>1</sup>:

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<sup>1</sup> At the time of writing this plan, another NOAA office – the NOAA Climate Service – has been proposed, but not adopted. If implemented, NWS collaboration with this new office will be every bit as vital as our collaboration with the current NOAA offices listed, especially with respect to integrated delivery of NOAA climate services.

- *National Environmental Satellite, Data, and Information Service (NESDIS)* – acquires and manages Nation’s environmental satellites, manages NOAA data centers, provides environmental data, and performs environmental assessments;
- *National Marine Fisheries Service (NMFS)* – conserves, protects and manages living marine resources within the United States;
- *National Ocean Service (NOS)* – protects coastal communities and monitor our coastal, Great Lakes, and deep-ocean waters;
- *Office of Marine and Aviation Operations (OMAO)* – manages and operates NOAA’s ships and aircraft while managing data acquisition technologies

In the future we envision NOAA offices working more closely together to deliver common services based on integrated environmental data and information. Looking beyond NOAA, we also rely on the expertise of other government agencies. The NWS vision of the future will require closer collaboration with local, state, and federal government agencies to provide more integrated, usable, and relevant information and services. NWS must strengthen relationships with many existing partners, while also developing new relationships that better enable integration of environmental information into emerging areas that have economic, environmental and health impacts. Examples of long-standing partnerships include FEMA, FAA, DOD, USGS, NASA and numerous state and local officials. NWS collaboration and partnership does not stop at U.S. borders. We will continue to foster global collaboration working through the United Nations process and international agreements. Global cooperation on observations, data exchange, modeling, research and development is key to our continued and future success.

## IMPLEMENTATION

The success of our strategy relies not only in the plan itself but in our ability to execute it. Our strategy must be integrated into everyday decision-making, reflected in our resource investments, and supported by all of our employees. Management processes must be fine-tuned to support strategic action at all levels and encourage integration with budgeting and performance management. To guide the implementation of the plan, NWS is developing two supporting roadmaps for services and science and technology that describe in more detail how and when we will execute the objectives and strategies needed to achieve our vision and goals. The Services Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Climate, Water, and Weather Services, will define NWS operational and human capital strategies needed over the next ten years. The Services Roadmap will be supported by the Science and Technology (S&T) Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Science and Technology. The S&T Roadmap will enable enterprise solutions and allow for continuous improvements across the NWS science service areas.

For more information, visit [www.weather.gov/com/stratplan](http://www.weather.gov/com/stratplan).